



# Introduction

## The Directive

The California Environmental Protection Agency (Cal/EPA) released its first *Strategic Vision* document in July 2000 (Cal/EPA, 2000). In that document, Secretary Winston H. Hickox called for a new agency orientation based on the use of novel strategies to address the complex environmental challenges of the twenty-first century. Secretary Hickox also committed Cal/EPA to focus on measurable environmental results in judging the effectiveness of the state's environmental protection programs. To support this commitment, Cal/EPA made the adoption of environmental indicators a priority in the Agency's planning and decision-making processes.

Recognizing the need to address environmental protection issues in tandem with resource management issues, Secretary Hickox and Resources Secretary Mary Nichols agreed to collaborate in the development of environmental indicators for areas where the missions of the two agencies overlap. (Indicators that address areas that are primarily the

responsibility of the Resources Agency will be developed and implemented under that agency's strategic planning functions.)

Environmental indicators present scientifically-based information on the status of, and trends in, environmentally-related parameters. They convey complex information in a concise, easily understood format, and have a significance extending beyond that directly associated with the measures from which they are derived. Environmental indicators will support the development and implementation of a "results-based management system" for Cal/EPA. Under this management system, environmental indicators will be considered in strategic planning, policy formulation, resource allocation, and priority setting. The environmental indicators will also be used to communicate information about California's environment to the public.

Specifically, environmental indicators will help track progress toward meeting the following goals specified in Cal/EPA's *Strategic Vision*:

- Air that is healthy to breathe, and sustains and improves our ecosystems, and natural and cultural resources.
- Rivers, lakes, estuarine, and marine waters that are fishable, swimmable, and support healthy ecosystems and other beneficial uses.
- Groundwater that is safe for drinking and other beneficial uses.
- Communities that are free from unacceptable human health and ecological risks due to exposure from hazardous substances and other potential harmful agents.
- Ensure the efficient use of natural resources.
- Eliminate the disproportionate impacts of pollution on communities.

The Office of Environmental Health Hazard Assessment (OEHHA) was directed to lead a collaborative effort to develop a process for identifying and selecting environmental indicators, to generate an initial set of indicators, and to maintain the environmental indicator system. The Environmental Protection Indicators for California (EPIC) Project was

created to carry out this directive. Over the past year, OEHHA has worked closely with various collaborators, including technical staff from the boards and departments of Cal/EPA, the Resources Agency, the Department of Health Services, and Region 9 of the U.S. Environmental Protection Agency (U.S. EPA). Input into the project is provided by an Interagency Advisory Group of policy-level representatives from various state agencies and U.S. EPA, and by an External Advisory Group consisting of representatives of non-profit environmental/public interest groups, local governments, the private sector, and academia.

This document describes the process that will guide the identification and selection of environmental indicators; this process may be revised, as needed. This document also presents the initial set of environmental indicators. This initial set will be evaluated, improved and expanded on an ongoing basis to ensure that it provides meaningful information for better understanding the state of California's environment, and for planning and decision-making.

## Overview of Environmental Indicators

Increasing concern over environmental issues in recent decades has prompted efforts to develop environmental indicators. These indicators provided a means of simplifying environmental data for decision-makers and the public (Hammond, 1995). The early work of the Organisation for Economic Co-operation and Development (OECD), an international organization charged with promoting policies to achieve sustainable economic growth, was most notable in the field. In 1989, the OECD Council called for further work to integrate environmental and economic decision-making (OECD, 1993), a charge that was echoed in a request to OECD by the Group of Seven economic powers after its Economic Summit in the same year. The OECD also launched a program of environmental performance reviews to help improve the individual and collective performance of its member countries in environmental management.

Environmental indicators are used by international organizations (such as OECD and the United Nations), by many countries (most notably The Netherlands, Canada, New Zealand, and Australia), by the federal government (U.S. EPA), by other states (such as New Jersey and Florida), and by governmental and non-governmental organizations at the regional and local levels (such as the City of Santa Monica and the Silicon Valley Environmental Partnership). Uses of environmental indicators by these various entities range from the communication of information about the state of the environment to providing specific considerations for strategic planning, goal-setting, and policy-making. (See reference list at the end of this chapter for full citations for indicator reports and/or web sites for these various entities.)

## Conceptual Model for Environmental Indicators

Most environmental indicator systems are built around the “pressure-state-response” (PSR) model developed by OECD, or a variation thereof, such as the “pressure-state-effects-response” (PSER) model developed by the U.S. EPA’s Office of Policy, Planning and Evaluation (U.S. EPA, 1995).

The PSER model is based on a concept of causality (see Figure 1). Human activities (as well as natural phenomena) exert pressures on the environment. For example, the use of leaded gasoline in vehicles until the 1970s resulted in lead emissions in vehicle exhaust. These pressures can change the quality and quantity of natural resources, the *state*. In the example given, the lead emissions resulted in increased concentrations of lead in air, which can result in elevated human blood lead levels. Changes in the state can then produce one or more adverse *effects* on human and ecological health, e.g., reduced IQ in children, in the case of lead. Society may then react to these changes by enacting new policies and regulations, the *response*. The banning of lead as a gasoline additive is an example. In principle, new policies or regulations should reduce the pressures on the state and, consequently, the effects. Certain responses may also be directed at the *state*, such as efforts to clean up sites contaminated with leaded gasoline, or at the *effects*, such as screening to identify and treat children with elevated blood lead levels. In some cases, the *state* may affect the pressure.

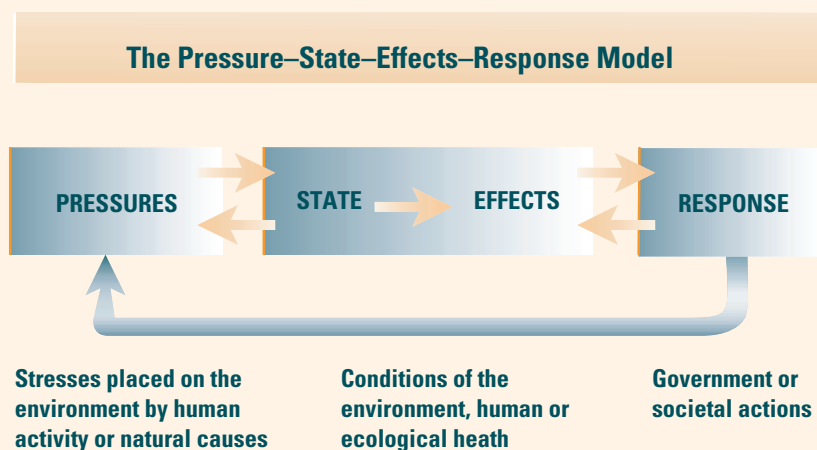


Figure 1

Adapted from: Organisation for Economic Cooperation and Development, 1993

### References:

Australian and New Zealand Environment and Conservation Council. *Core Environmental Indicators for Reporting on the State of the Environment*. Posted at: [www.environment.gov.au/soe/envindicators/coreindicators.html](http://www.environment.gov.au/soe/envindicators/coreindicators.html)

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City of Santa Monica. *Santa Monica Sustainable City Programs*. Posted at: [www.ci.santa-monica.ca.us/environment/policy/indicators.htm](http://www.ci.santa-monica.ca.us/environment/policy/indicators.htm)

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Florida Department of Environmental Protection. *Strategic Assessment of Florida's Environment*. November, 1994.

Hammond, A. et al. 1995. *Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development*. World Resources Institute, Washington, D.C.

The Netherlands. *Netherlands Measuring Environmental Progress 2000*. National Institute of Public Health and Environmental Protection. Bilthoven, The Netherlands. Posted at: [www.netherlands-embassy.org/c\\_envind.html](http://www.netherlands-embassy.org/c_envind.html)

New Jersey Department of Environmental Protection. *A Guide to Environmental Indicators in New Jersey: Managing for Environmental Results*. Posted at: [www.state.nj.us/dep/dsr/guide.htm](http://www.state.nj.us/dep/dsr/guide.htm)

A further refinement of the PSER model is used by the Chesapeake Bay Program, a partnership of federal, state and local governments, as its “hierarchy” of indicators (Figure 2) (U.S. EPA, 1999).

The indicators in this model can be characterized by their position in the hierarchy on a six-level scale, as follows:

- Level 1: Actions by regulatory agencies  
(example: issuance of a discharge permit)
- Level 2: Responses by the regulated and nonregulated community  
(example: compliance with allowable pollutant discharge limits)
- Level 3: Changes in discharges/emission quantities  
(example: discharge of a pollutant)
- Level 4: Changes in ambient conditions  
(example: water concentrations of a pollutant)
- Level 5: Changes in uptake and/or assimilation  
(example: uptake of pollutant by aquatic organisms)
- Level 6: Changes in health, ecology or other effects  
(example: changes in the population of aquatic organisms)

## References (cont.)

New Zealand Ministry for the Environment. *The State of New Zealand's Environment 1997*. Posted at: [www.mfe.govt.nz/about/publications/ser/ser.htm](http://www.mfe.govt.nz/about/publications/ser/ser.htm)

Organisation for Economic Co-operation and Development. 1993. *OECD Core Set of Indicators for Environmental Performance Reviews*. Environment Monographs No. 83. OCDE/GD(03)180. Paris.

Silicon Valley Environmental Partnership. 1999 *Environmental Index*. Posted at: [www.svep.org](http://www.svep.org)

United Nations Department of Economic and Social Affairs, Division for Sustainable Development. *Indicators of Sustainable Development: Framework and Methodologies*. Background Paper No. 3. Ninth Session, Commission on Sustainable Development, April 16-27, 2001, New York.

United Nations Environment Programme, Division of Environmental Information, Assessment and Early Warning. 1999. *Global Environment Outlook 2000*. United Nations Environment Programme, Nairobi, Kenya. Posted at: [www.grida.no/geo2000/](http://www.grida.no/geo2000/)

U.S. Environmental Protection Agency, Chesapeake Bay Program. July 1999. *Environmental Outcome-Based Management: Using Environmental Goals and Measures in the Chesapeake Bay Program*. EPA903-R-99-014 CP/RRS 223/99. Posted at: [www.chesapeakebay.net/pubs/indpub/indpub.htm](http://www.chesapeakebay.net/pubs/indpub/indpub.htm)

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Administrative		Environmental			
Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Actions by EPA/State Regulatory Agencies	Responses of the Regulated & Nonregulated Communities	Changes in Discharge or Emission Quantities	Changes in Ambient Conditions	Changes in Uptake and/or Assimilation	Changes in Health, Ecology or Other Effects
Response		Pressure	State		Effects

Figure 2. The Chesapeake Bay Hierarchy of Indicators

Although the indicators toward the higher end of the continuum (Levels 4 through 6) portray a clearer, more direct image of the environmental conditions, indicators at the lower levels (Levels 1 through 3) are needed to establish a link between the actions taken and effects observed. It is important to maintain indicators along the continuum in order to demonstrate the linkage between human activities and responses in the natural system.

The focus of the EPIC Project is on the environmental indicators, Levels 3 through 6. Administrative indicators, Levels 1 and 2, are addressed in the strategic planning process.